HEALTH AND SAFETY ACTIVITIES OF THE BUREAU OF MINES, FISCAL YEAR 1955

By James Westfield

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Information Circular 7732

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James Westfield[1/]

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1/ Assistant Director - Health and Safety, Bureau of Mines, Washington, D. C.

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INTRODUCTION

Bureau of Mines activities for safety and health in the mineral industries were reorganized during the fiscal year to provide direct supervision by the Assistant Director - Health and Safety. On December 19, 1954, the field offices conducting these activities were designated as district health and safety offices reporting to the Assistant Director. The functions of determining the causes of accidents and injuries in the mineral industries and recommending measures to eliminate them were continued, with satisfactory results in improved safety records. The inspection of coal mines and enforcement of the Federal Coal Mine Safety Act of 1952 were conducted as directed by the Congress, and safety conditions in the mines were notably improved. One coal-mine explosion classed as a major disaster occurred during the year. The causes of that explosion and means for preventing a recurrence were still under investigation because of the extreme difficulty in recovering several portions of the mine.

Basic research on the nature of certain hazards and ways of eliminating them is continued. Training of individual workmen and supervisors in this knowledge is a major part of the work.

ACKNOWLEDGMENT

The material from which this report was compiled was prepared by the chiefs of the divisions and branches of the health and safety organization.

WORK ON PRIMARY HAZARDS

The two most serious hazards from the standpoint of frequency and severity of injuries to mine workers are roof falls and haulage. Roof falls caused 55 percent of all fatalities in coal mines in 1954, and haulage accidents caused another 23 percent, a total of 78 percent from both. A national campaign to reduce the number killed and injured by falls of rock and coal has been conducted jointly by the Bureau and other national and mineral-industry organizations. Definite results, in reduced numbers of killed and injured, are expected to be shown by the end of 1955. The Bureau has continued its educational program to promote safer practices in controlling roof, haulage, and other operations.

Roof bolting, a method of roof support that the Bureau introduced to the coal-mining industry in 1947, has proved its effectiveness in preventing roof-fall fatalities and continues to gain wide acceptance. During 1954, 120 underground mechanized coal mines used roof bolts exclusively, and 26 percent of the entire production of bituminous-coal mines was mined in roof-bolted areas. Significantly, of the 177 roof-fall fatalities that occurred in bituminous-coal mines during 1954, only 2 resulted from failure of the bolts to support the roof.

In future, the risk of failure of bolted mine roof may be lessened by using a safety device referred to as a roof-bolt compression pad. During fiscal year 1955

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the Bureau, seeking to make roof-bolting installations more reliable, developed a rubber-in-steel bearing plate, and a similar device has been produced by industry that appears to be promising as an effective warning device of impending failure of bolted roof.

Recent field and laboratory tests provided the information for determining anchorage effectiveness, torque-tension relationship, and load-carrying capacities of the types of bolts and expansion shells normally used in underground mines. A report embodying the results has been prepared for publication and will be available to the mining industry during fiscal year 1956.

Besides routine roof-control mine examinations, conferences were held during the year with mining-company officials, inspectors of State mining departments, and engineers from various parts of the United States and foreign countries on roof-bolting and roof-control problems. Roof-bolt installations in all districts were surveyed, and reports were submitted to miners' unions, operators, State inspectors, and Bureau headquarters in Washington. Other roof controls studied included extensible canopies, shields on continuous mining machines, curved jacks for longwall continuous mining machines, bonding, and roof painting.

TESTS OF EQUIPMENT

The Bureau's electrical-mechanical test work contributed to improvement of coal-mine safety by: (1) Investigating electrically operated machines and appliances to determine whether they are constituted so as to minimize gas-and-dust ignition hazards as well as electric shock; (2) testing diesel-engine-powered mine locomotives and equipment for safe underground operation (fig. 1); (3) research to determine causes and prevention of accidents to men who work with or around mining equipment; and (4) studying methods for providing better lighting in mines.

During the fiscal year 1955 electrical-mechanical activities included more than 1,600 explosion tests of electrical compartments and enclosures, which led to the formal approval of 73 designs of electrical mining equipment. During the year, 165 approvals were granted, and 2,043 approvals were extended. In addition, 1 electric trip light, 1 flashlight, 1 methane detector, and 4 diesel-powered machines were tested and approved. The mine-lighting study was continued during the fiscal year 1955, and a tentative schedule was prepared for safe lighting equipment for underground illumination in gassy or dusty mines.

To assist the Navy Department in eliminating fire and explosion hazards on aircraft and ships the Bureau investigated, under cooperative agreement with the Navy Department, 12 electrical components and 3 aircraft fuel gages and made 358 explosion tests.

State and Federal laws and regulations require the use of Bureau of Mines-approved equipment in gassy coal mines; therefore, the investigation and testing of electrical mining equipment is a very important activity that will be continued in the fiscal year 1956. Other current activities are studying diesel-powered equipment and testing fire-resistant belts for underground use.

Future electrical-mechanical, long-range activities embrace current investigations and testing, which is of a continuing nature, and new developments in mechanized equipment. It is proposed to investigate the means of reducing gas-ignition and fire hazards from portable cables of electric machinery, which are a major cause of the hazards.

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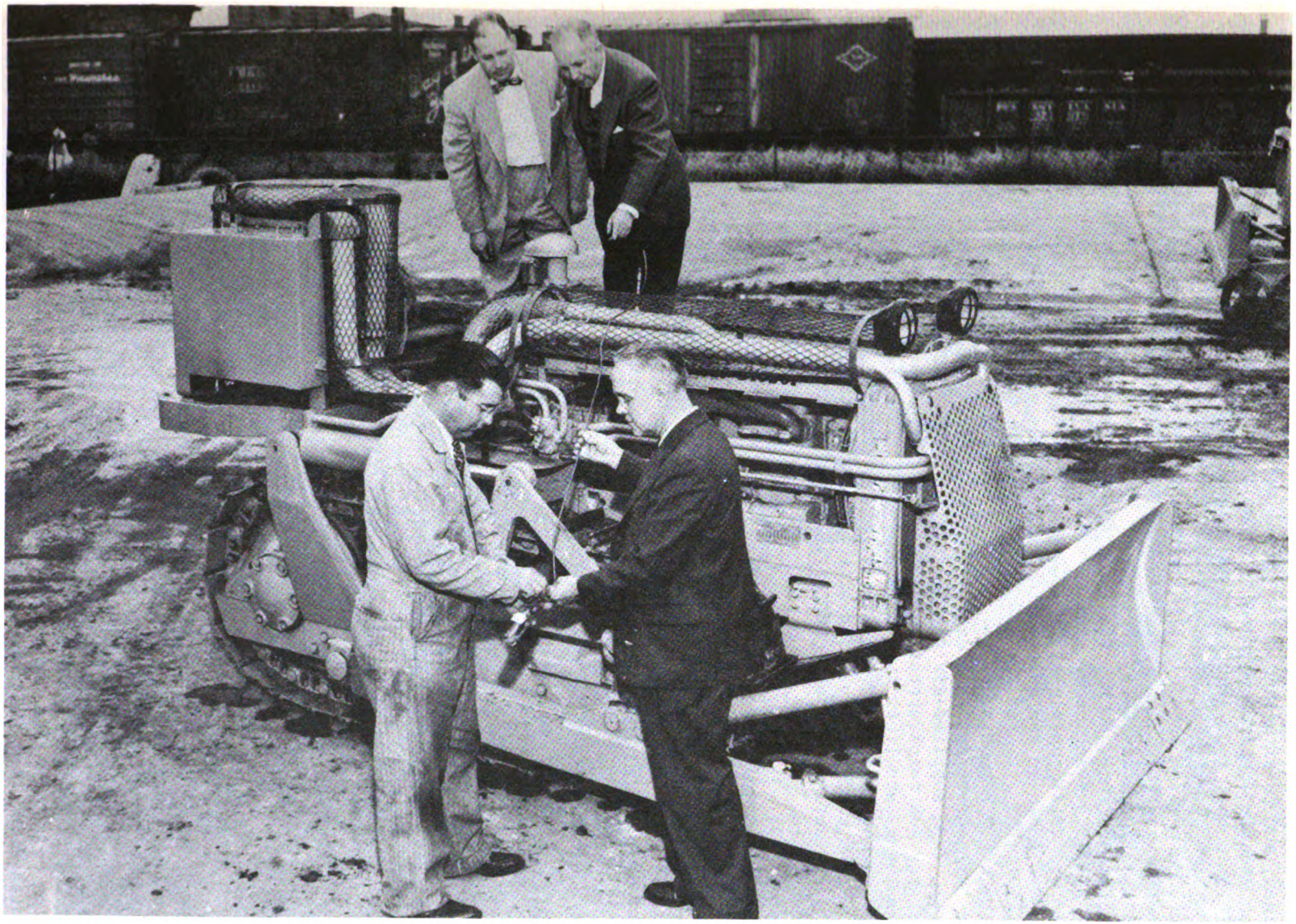

Figure 1. - Bureau of Mines engineers make rigid test on diesel tractor intended for underground use. (Courtesy, J. D. Pittman Tractor Co.)

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Seventeen approvals were granted for dust collectors for use in rock drilling in coal mines, and 20 extensions of approval were granted to cover minor modifications in previously approved equipment. (See fig. 2.) A significant development in this field is that four manufacturers were granted approval on drills equipped with hollow drill steel, through which dust and cuttings are drawn and delivered to a filter. A revised schedule (25A) covering approval requirements for drill-dust collectors was issued on April 23, 1955. An experimental coal mine with parallel entries of approximately 270 feet was essentially completed on Government-owned property at Bruceton, Pa. (fig. 3), and will be used for approval testing of drill-dust collectors and other studies relating to mine dust. A high-speed, hydraulic, rotary drill capable of drilling at rates as high as 14 feet per minute was obtained for use in the dust-collector tests.

A total of 59 requests was received for extensions of existing approvals on respiratory protective devices, and 41 extensions of approvals were granted - 32 on gas masks, 2 on supplied-air respirators, 4 on dispersoid respirators, and 3 on nonemergency gas respirators. Requests were received also for approval testing of 6 new gas masks and 1 new type C, supplied-air respirator. Approval BM-1928 was granted on the M. S. A. Dusfoe air-line respirator. Preliminary examinations were made on and consultations held with respirator manufacturers regarding eight respiratory protective devices. Suggestions were made for correcting features considered unsuitable.

Further aging tests of universal-type, gas-mask canisters produced additional evidence that this type of canister attached to timer and face-piece should be stored with the bottom seal intact and that after such canisters have gained 45 grams in weight, owing to absorption of atmospheric moisture, they should be discarded (see fig. 4). Development work was completed on apparatus for testing respirators (fig. 5) against a predetermined and uniform concentration of mists formed while spraying lacquer, enamel, and lead paint. Approval requirements for paint-spray respirators will be based on this work.

HEALTH

General

Activities of the Division of Health were directed to studying and evaluating conditions affecting the quality of the working environment in the mining and allied industries, and to promoting safe and healthful working conditions by providing information on the composition of mine atmospheres (fig. 6), enabling control of undesirable or unsafe conditions caused by gases and dusts; by testing and evaluating equipment for respiratory protection against such atmospheric contaminants; and by studies dealing with improvement of mine ventilation and other conditions relating to the quality of the air in underground workings.

Gas

The continuing study of the composition of mine atmospheres provides the Bureau of Mines with information on this subject accumulated on a nationwide basis. The results obtained in this work are available to State mining departments, to the mining companies concerned, and to miners' unions. In case of mine fires or explosions, gas analyses may be conducted at the scene to expedite rescue or recovery operations. Such an operation was carried out at a West Virginia coal mine after an explosion costly in life and property damage had necessitated sealing the mine to extinguish fires that followed the explosion. Numerous gas analyses made at the

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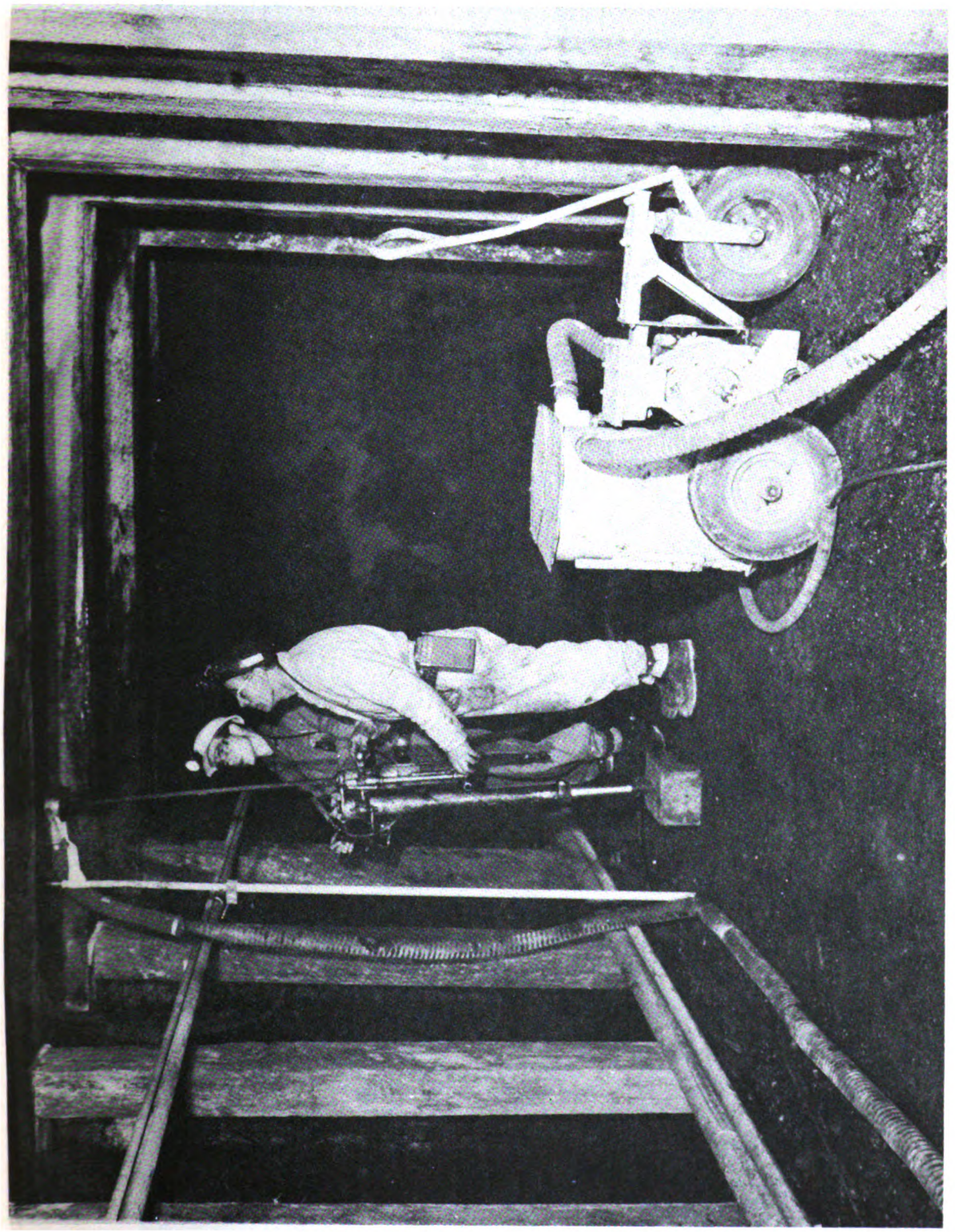

Figure 2. - Approval testing a drill-dust collector in Branch of Health Research Experimental coal mine near Pittsburgh, Pa.

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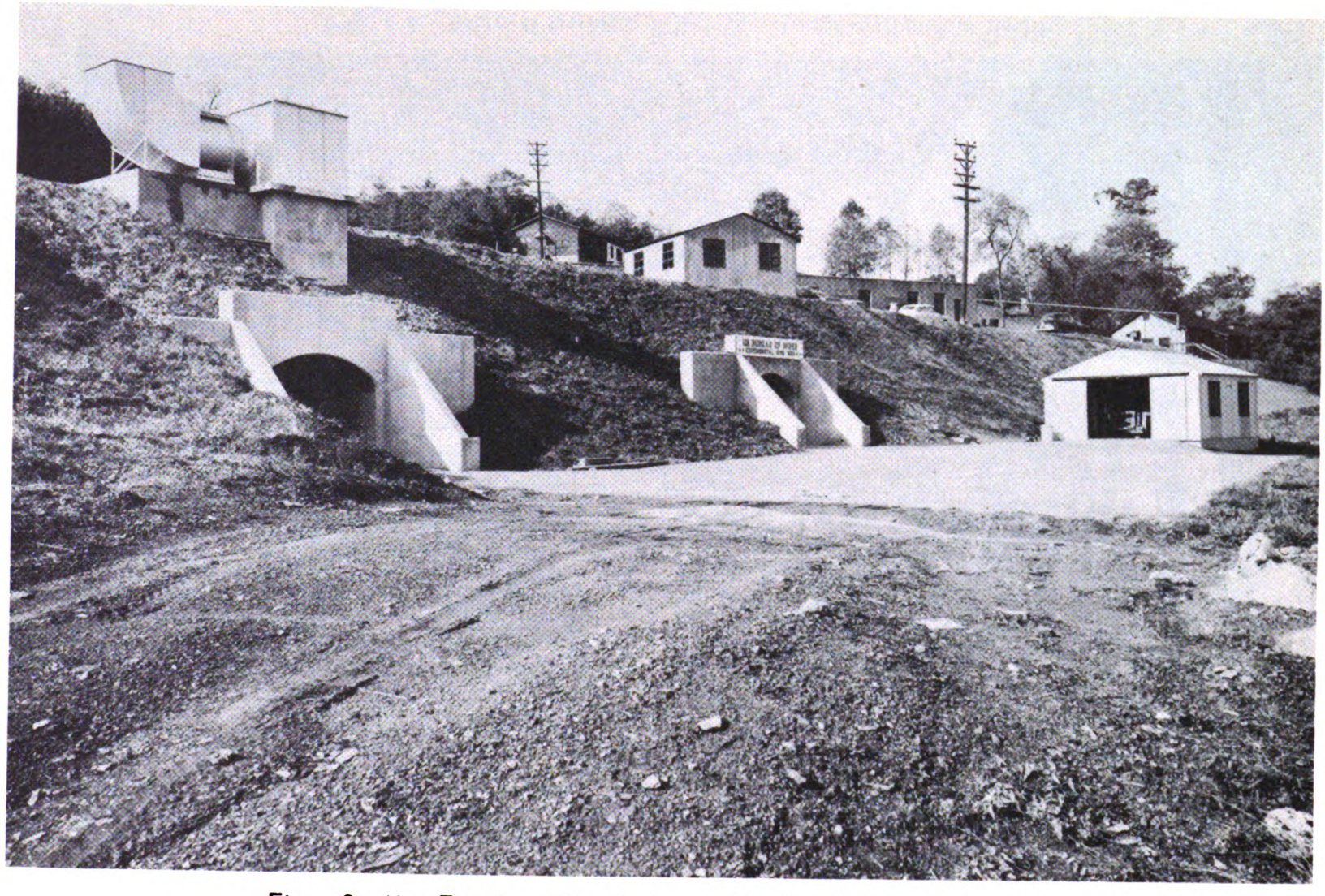

Figure 3. - New Experimental coal mine used by Branch of Health Research for approval testing of drill-dust collectors and for other specialized studies pertaining to dust in mines. Mine is near original Experimental coal mine south of Pittsburgh, Pa.

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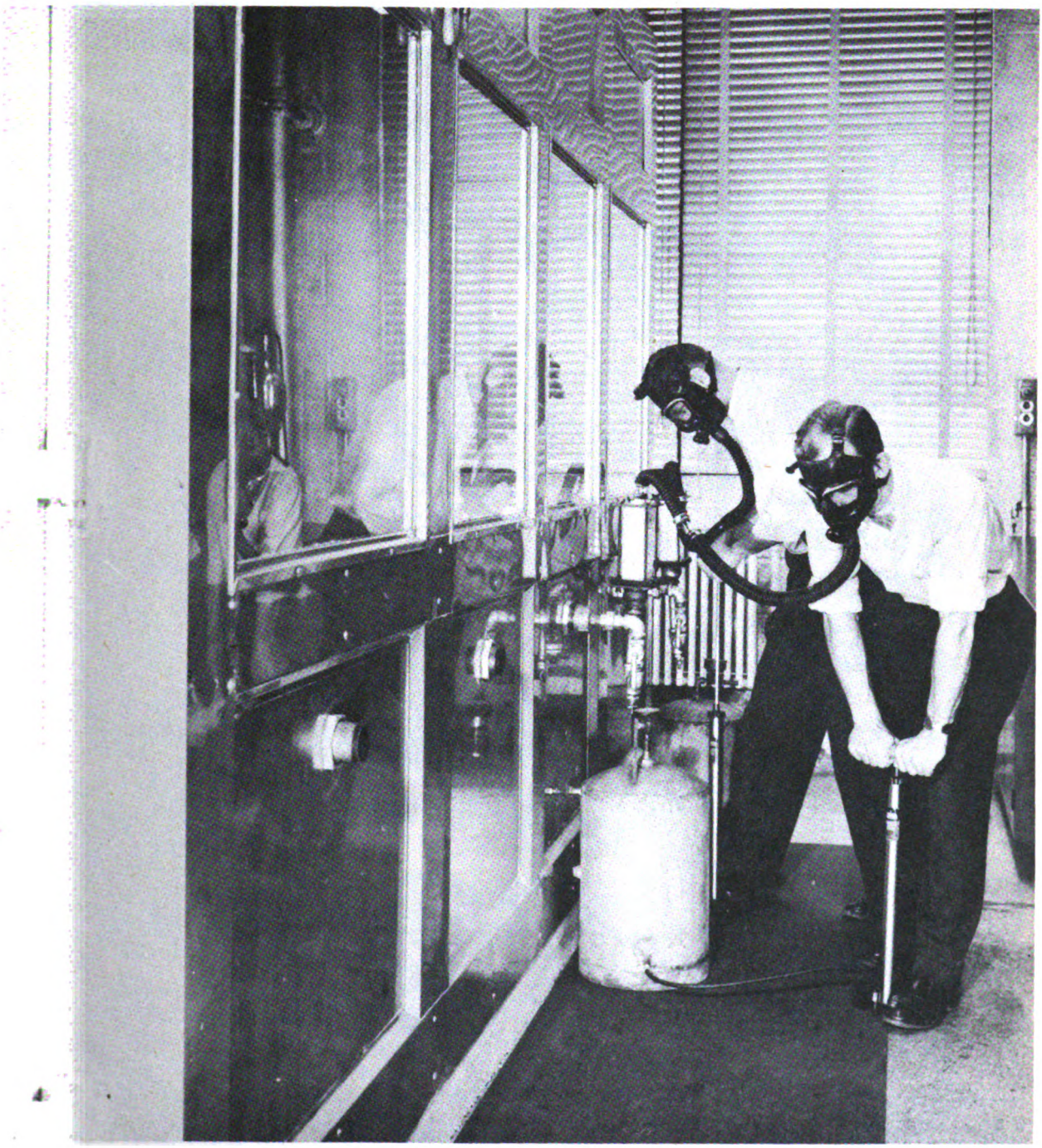

Figure 4. - Testing gas mask canisters in Bureau laboratory.

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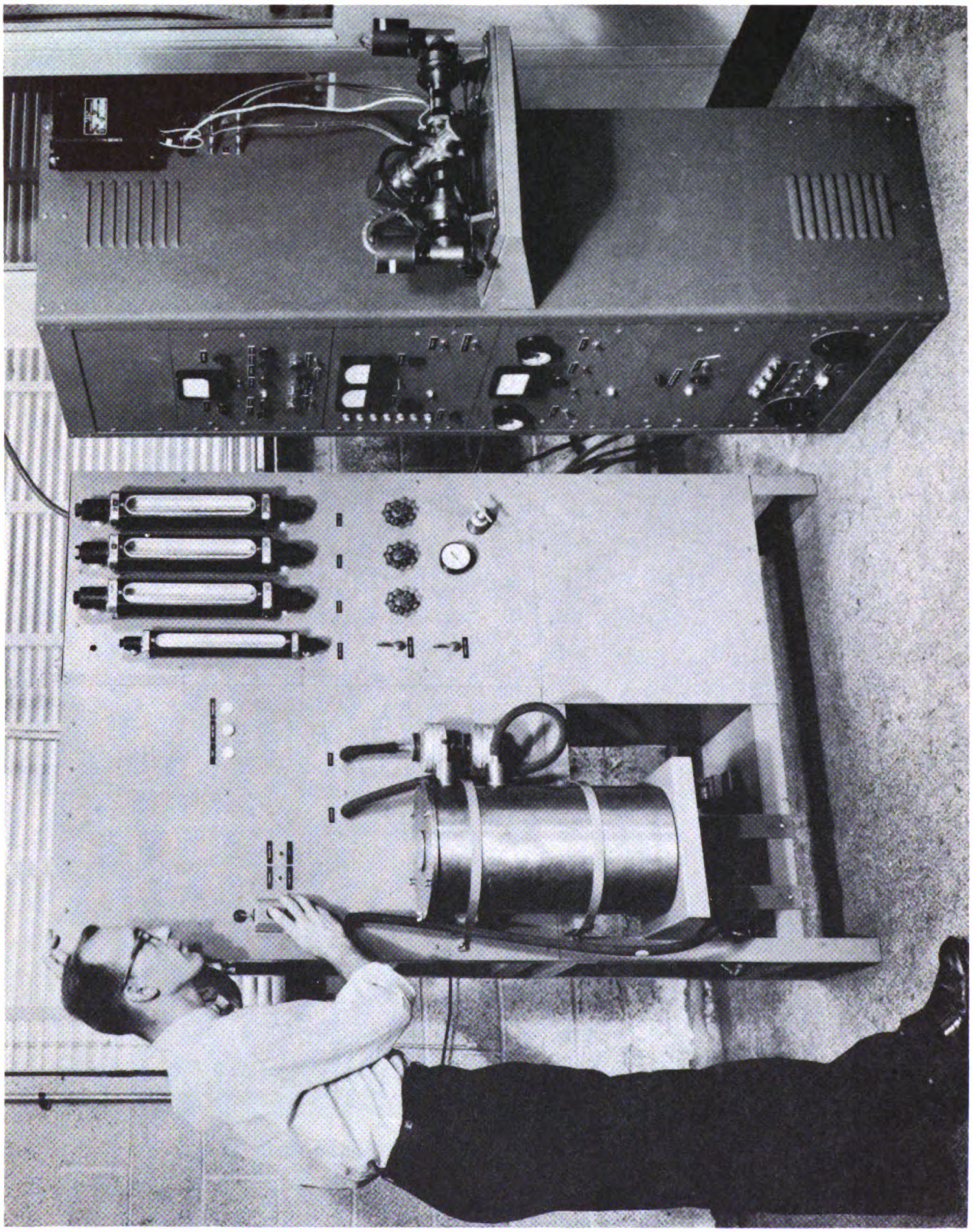

Figure 5. - Apparatus used in approval testing of respirator filters.

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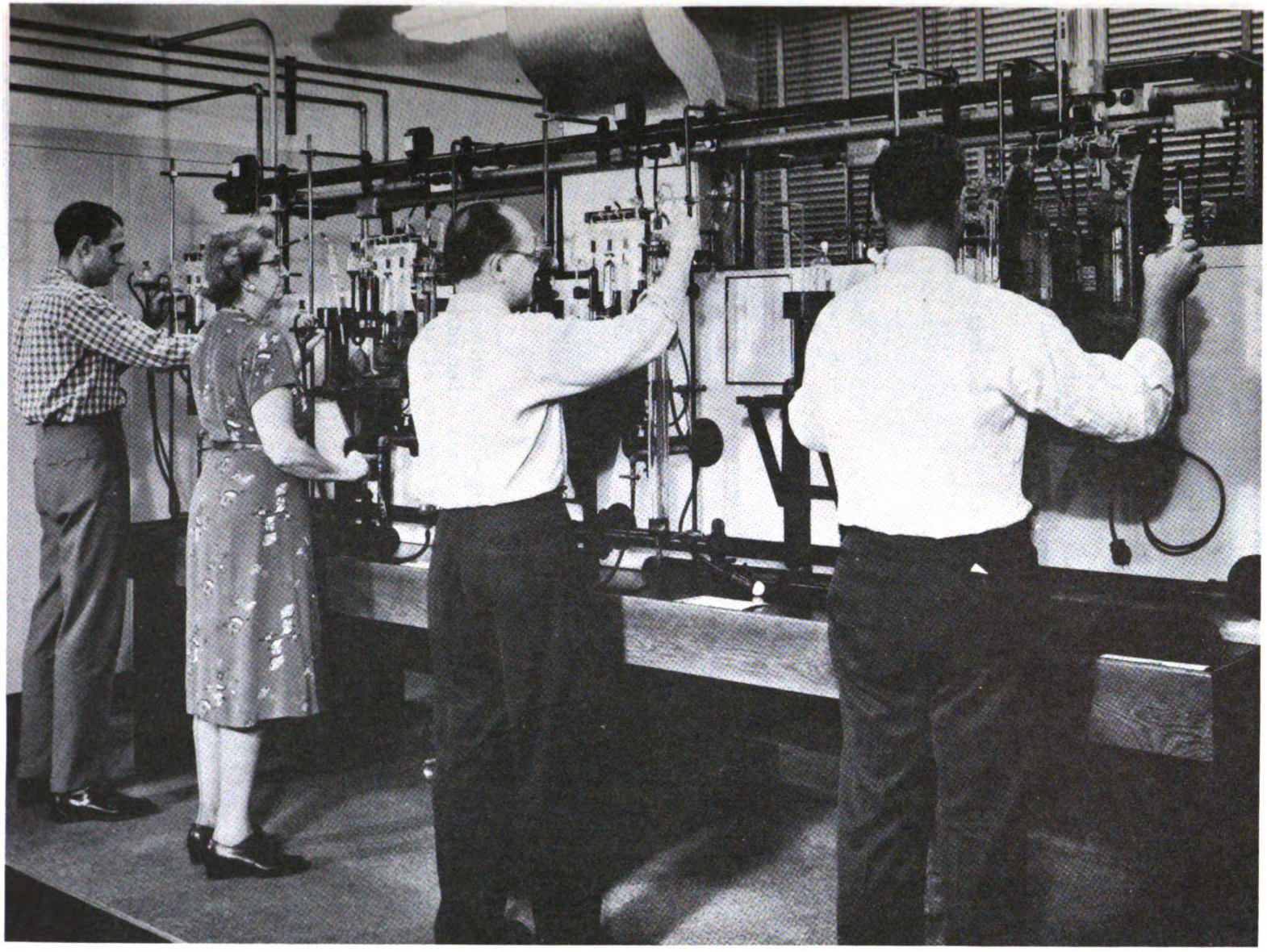

Figure 6. - Bureau of Mines laboratory for analyzing samples of mine atmosphere collected by Federal coal-mine inspectors.

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scene to assure the safety of recovery operations greatly facilitated the reopening of the mine.

A total of 18,321 gas samples was analyzed and reported; of these, 16,410 were in connection with the conduct of the Bureau's program of coal-mine inspection. The others were collected from sealed fire areas in coal mines; metal and salt mines; tunnels under construction; coal-preparation plants; and in connection with testing and underground use of diesel and butane engines, plastics and conveyor belt decomposition, and miscellaneous laboratory and field investigations. Over 350 gas samples were analyzed at the scene of operation in sealing and unsealing fire areas in coal mines.

Studies were continued for the Bureau of Ships, Department of the Navy, to determine ignition and burning characteristics and nature and quantity of toxic gases produced by combustion or thermal decomposition of plastic materials for shipboard use and other military applications.

As part of the work of a committee, consisting of Bureau personnel and representatives of conveyor-belt manufacturers, coal operators' associations, the miners' union, and the State of Kentucky, tests were conducted to determine the gaseous products formed by burning or thermal decomposition of rubber-covered conveyor belts and fire-resistant conveyor belts of Neoprene and polyvinylchloride (see fig. 7). The objective of the committee was to formulate specifications for fire-resistant conveyor belts to use in coal mines. A proposed schedule of acceptance requirements was completed.

A double-beam, dispersion-type, recording, infrared spectrometer was obtained primarily to determine both qualitatively and quantitatively the methane content of certain samples of coal-mine atmospheres (fig. 8).

Dust

X-ray diffraction apparatus of the Geiger-tube, goniometer, scanning type was calibrated for determining free silica in dust and other mineral materials (fig. 9) and was employed to analyze 34 samples from a variety of sources. Emission spectroscopy was used to analyze 60 samples from various sources, and work was begun to determine the feasibility of determining silicon by this method as a substitute for chemical determination of total silica in rock dust for coal-mine use.

Counts of dust particles by the light-field microscopic technique were made on 1,183 impinger samples collected in various field and research investigations, and 44 particle-size distribution determinations were completed. Experimental work was done on development of a thermal precipitator dust sampler suitable for use in gassy coal mines. This device would enable dust to be sampled so that electron-microscope examinations of the collected dust could be made directly without redispersion. Studies were made of the sampling efficiency of the midget impinger as related to the velocity of the air sampled. A scale model of two connected mine entries was constructed to determine the behavior and flow pattern of air currents as related to dust transport.

The control of dust produced by the continuous-type mining machine is one of the problems that confronts the coal-mining industry. The effects of various types of spray nozzles as dust suppressors were observed, and arrangements were made to conduct field studies on this problem in several Alabama coal mines.

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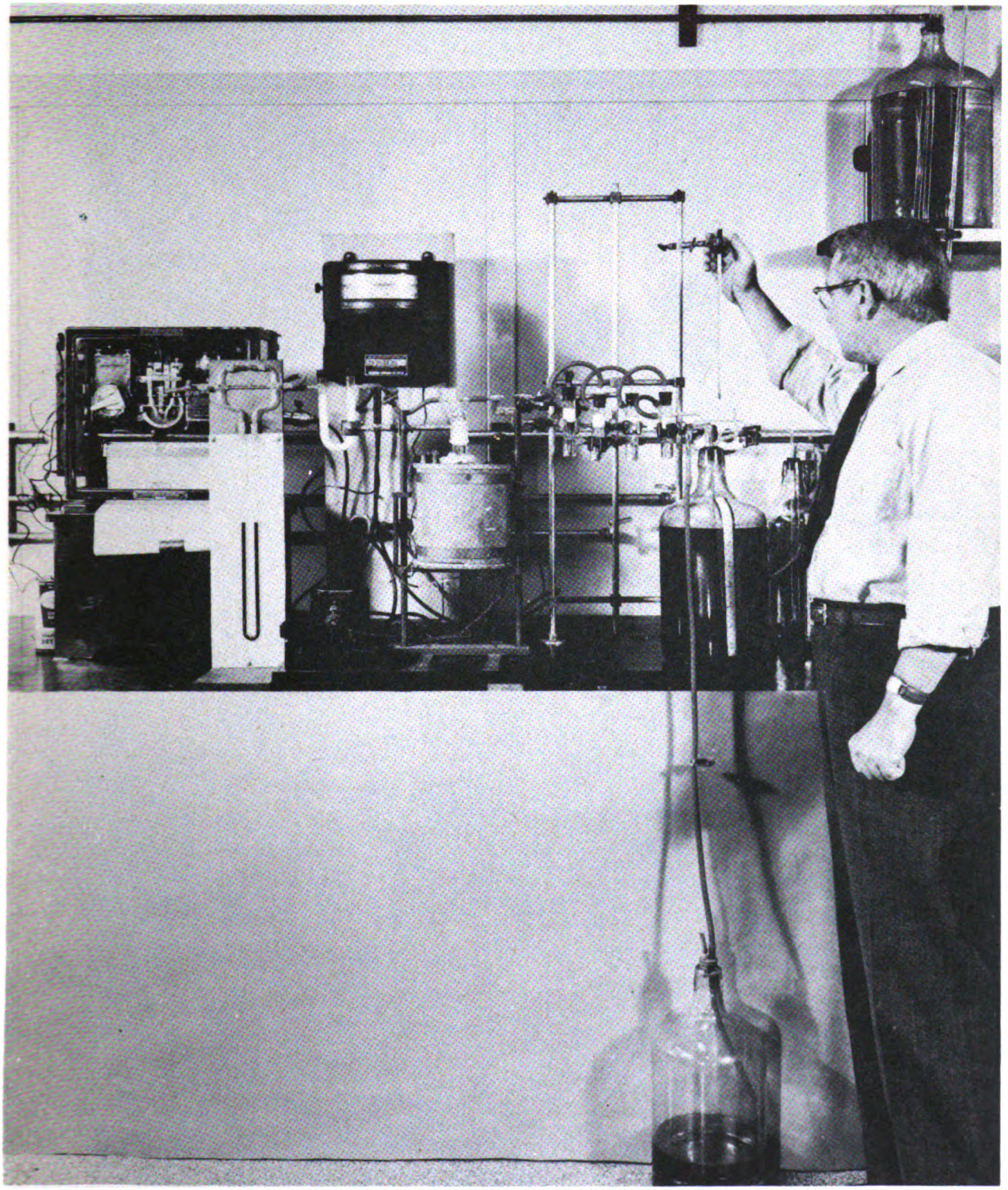

Figure 7. - Apparatus for studying composition of toxic gases from frictional overheating of coal-mine conveyor belts.

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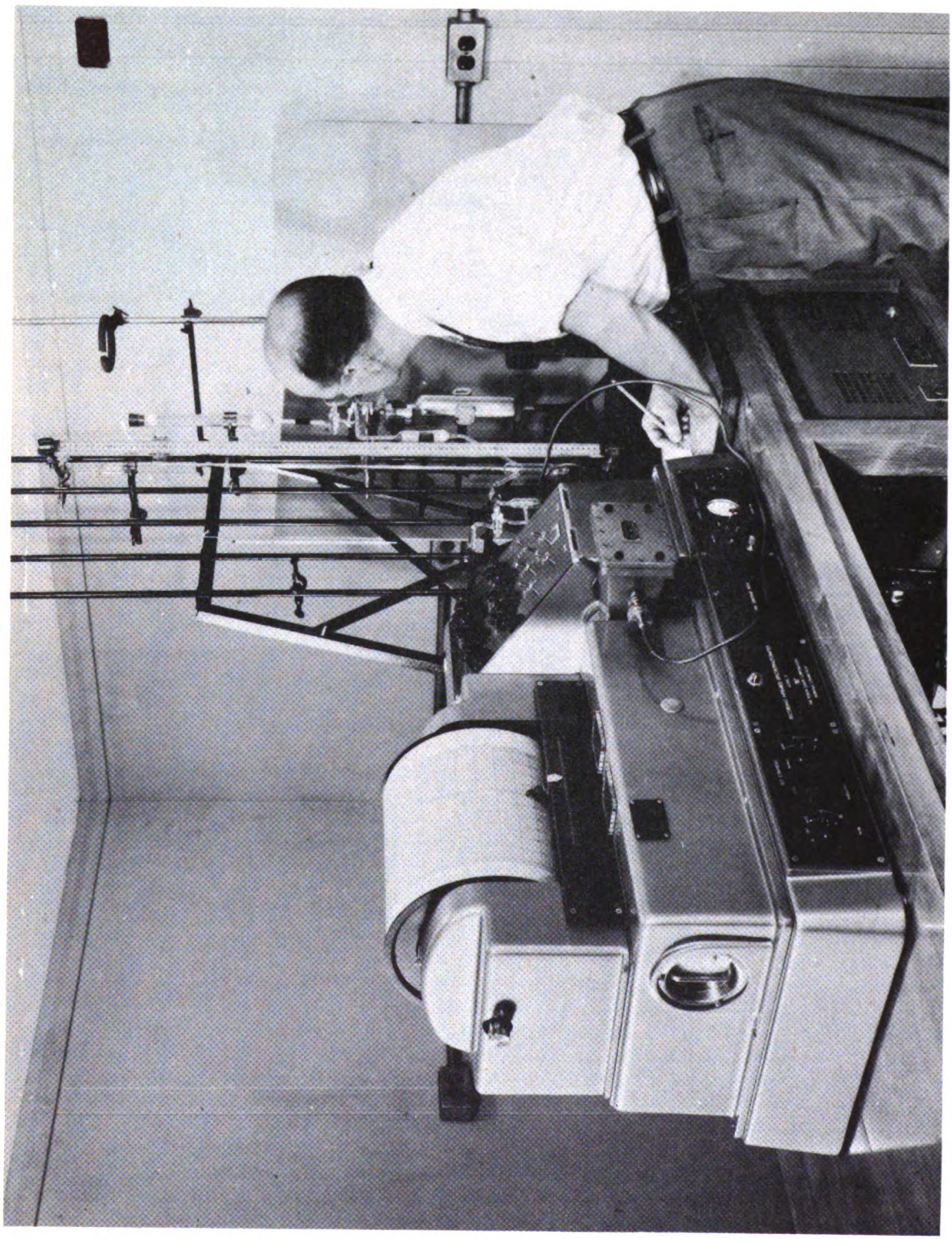

Figure 8. - Infrared absorption spectrometer used primarily for analyzing methane in coal-mine air samples.

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Figure 9. - X-ray diffraction apparatus used by Bureau of Mines for determining quartz and other crystalline substances in mine dust, minerals, and other dust-source materials.

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A survey of dust-control practices in the coal-mining industry, which was initiated during the preceding year and was conducted through the medium of a questionnaire circulated among Bureau coal-mine inspectors, was completed. The data provided by more than 3,400 replies to the questionnaire were analyzed and the results prepared for publication. The survey showed that about 24 percent of the mines used some form of dust control.

At the request of the International Labor Office, Geneva, Switzerland, an annual summary was prepared reviewing methods of dust prevention and suppression in mining, tunneling, and quarrying.

The major portion of the American Standard Code that deals with respiratory protection was rewritten by personnel serving on A. S. A. Sectional Committee Z2, appointed to correlate and edit material on head, eye, and respiratory protection.

Ventilation

Complete ventilation surveys were made and reports with recommendations were submitted for three coal mines. Records of a study made in February-April 1954 of the effect of barometric pressure changes on methane emission in caved areas in an Illinois coal mine were further analyzed, and a manuscript on this study was submitted for publication. A study of the effectiveness of bleeder entries in keeping caved areas in coal mines free of methane accumulations was begun. The new nonlinear electric analogue for the semiautomatic solution of mine-ventilation-distribution problems and electric-power network analyses was put into full operation for the first time in July 1954 (see fig. 10).

Future Programs

Present functions of the Division of Health will be continued. Future programs for the Branch of Health Research should have objectives of broad scope that would enable collection of information that would be useful on industrywide basis or would be applicable to specific phases of industry. Examples of studies that might be undertaken are: Ventilation of uranium mines and effect of ventilation on concentration of radioactive substances in mine atmospheres; review of air-conditioning practices in deep, hot mines in all countries where such mines are operated; and effect of underground diesel operations on quality of mine atmospheres.

ACCIDENT ANALYSIS

Important among the Bureau's accident-analysis activities are the yearly canvasses for injury and related employment in the coal, coke, quarry, metal, nonmetallic mineral, oil and gas industries. The data collected included the number and types of injuries, cause, accident agency, frequency of occurrence, severity of injury, and certain operating factors closely connected with safety in the mineral industries.

After all data were reviewed and processed through various machine tabulating equipment, publications were prepared for the mineral industries, agencies of the Federal and State governments, labor unions, trade associations, and others interested in promoting safety in the mineral industries.

Special tabulations were prepared for the Federal inspectors showing the safety performance at individual coal mines to improve the effectiveness of their inspections of mines. Data on coal-mine inspection provided information for planning and administrating the Bureau's coal-mine inspection work.

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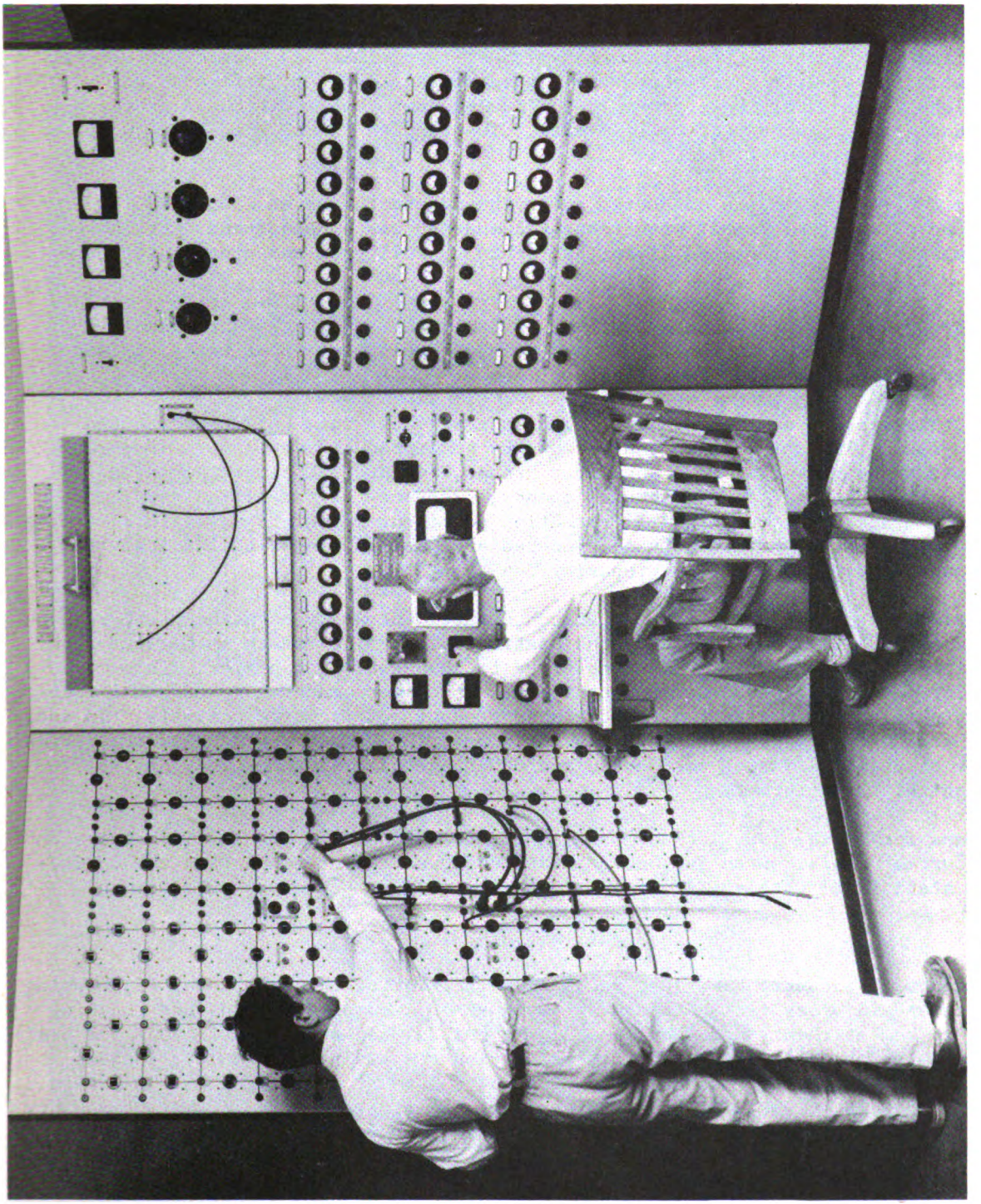

Figure 10. - Bureau of Mines electric analogue for semiautomatic solution of complicated mine-ventilation problems.

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The 30th National Safety Competition and four other safety competitions were conducted during the fiscal year 1955. These were sponsored by trade associations of the mineral industries. Approximately 1,500 mines, quarries, and other mineral plants were enrolled in these contests. Approximately 2,000 certificates of Accomplishment in Safety were prepared and presented to the individuals at the plants and to the managers of these plants. The results of these contests were published and distributed widely.

The annual canvass was conducted among the manufacturers of industrial explosives, and a technical report with tabular summaries was prepared and distributed to the makers of the products, libraries, schools, colleges, and other interested persons.

Three chapters were prepared for the 1953 Minerals Yearbook that contained current data pertaining to the injury and related employment experiences in each major group of the mineral industries.

Monthly reports on the fatality experience at coal mines were prepared and released for public information and for use by coal-producing companies, Federal inspectors and engineers, trade and labor groups, and State mining departments. These reports contained data on cause, agency, frequency of fatalities on a man-hour and tonnage basis, and other information pertinent to safety in the coal-mining industry. Monthly reports were also prepared and published showing the nonfatal-injury experience in mining and preparing coal.

During the past fiscal year the Branch of Accident Analyses assumed the responsibility of work previously done by the Statistical Service Branch at College Park. The equipment and personnel were transferred to the Washington office. This move called for changes in personnel and equipment, which were made at substantial monetary savings, and has expedited the finished products of accident analysis. In addition to accident analysis for the Bureau of Mines, the branch did machine statistical work for other divisions of the Bureau and other agencies of the United States Department of the Interior.

Plans for fiscal 1956 include issuing injury data on the mineral industries on a more current basis. Deadline dates have been advanced for completing the collection of statistical data in the field without increasing personnel or equipment.

SAFETY EDUCATION

Leaders of industry have long recognized that one of the best means of reducing accidents and injuries is to educate the workman to recognize hazards and teaching him how to combat them. For years the Bureau has devoted special effort to the coal-mining industry by conducting accident-prevention classes (see fig. 11), because coal mining is one of the most hazardous of the important industries of the Nation. At first, the effort was directed mainly toward training supervisors. Since January 1947 more emphasis has been placed on training the workman, and approximately 125,000 persons have taken the Bureau's 20-hour accident-prevention training course. Although the course is designed primarily for workmen, it has been considered helpful for morale building to have both supervisory officials and workmen take the Bureau's 20-hour course together. In fact, recent emphasis has been placed on 100-percent participation by both workmen and supervisors where the course is presented.

During the fiscal year 1956 it is planned to further emphasize 100-percent training at each facility where an accident-prevention training course is given.

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Figure 11. - Federal coal-mine inspector instructing accident-prevention course for workers and supervisors.

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Experience has proved that best results in the reduction of accidents and injuries are obtained where every person on the job takes the course. The promotion and enforcement of safety are not limited to management, supervisory officials, or workmen. To obtain best results, united cooperative effort must be exerted. The concept of teamwork must be instilled. The ultimate goal is to make accident-prevention training available to each person who goes underground in the coal-mining industry. Also, during the fiscal year 1956 the Bureau will continue accident-prevention training work for the mining industry other than coal as well as the petroleum and natural-gas industries. Limited personnel and funds have restricted the extent of this work, which has been confined largely to supervisory officials. Bureau training in these fields has been largely first aid.

Since July 1, 1910, approximately 1,850,000 persons throughout the mineral industries have taken the Bureau's first-aid training course, which includes initial training and the refresher course. Approximately 106,000 persons have taken the Bureau's mine rescue course. Approximately 38,000 persons have taken both first aid and mine rescue. The Bureau maintains interest in this fundamental safety work by sponsoring and participating in first-aid contests of a local, State, and national nature. It also sponsors the work of the Holmes Safety Association, a national organization that provides an excellent forum for the discussing accidents and ways to prevent their recurrence. A special effort was made during the year to promote the organization of Holmes Safety Association chapters and councils; 130 such chapters and 6 councils were organized during the year. Holmes Safety Association chapters and councils are an excellent means of promoting safety as they afford an opportunity for men and management to discuss accidents and safety measures.

Future plans for accident-prevention education are to continue and extend present activities. Appropriations will be requested to employ personnel so that the workmen and officials in all the mineral industries will have the opportunity to take a Bureau accident-prevention course designed for each type of mineral industry. It is planned to train every workman and official in the coal-mining industry and to institute retraining. The expenditure of Federal funds will benefit the mineral industries because accidents and injuries are wasteful and costly with respect to losses in manpower, equipment, and property. The continued training in the Bureau's first-aid course will not only be beneficial as a life-saving device in industry, but the persons so trained provide a reservoir of skill that will be of incalculable value if this country is bombed or invaded.

COAL-MINE INSPECTION

The end of fiscal 1955 was the third full year of operation under the Federal Coal Mine Safety Act, which consists of Title I, the original Federal Coal Mine Inspection and Investigation Act of 1941, with slight changes, and Title II, containing certain mandatory provisions designed to prevent explosions, fires, inundations, and man-trip and man-hoist accidents in coal mines employing regularly 15 or more individuals underground.

During fiscal 1955, 3,595 routine inspections were made of coal mines covered under Title II of the act, including 52 made jointly with State inspectors in States that have entered into cooperative agreements with the Bureau under the provisions of the act. In addition, 2,794 special inspections were made to determine the abatement status of violations of Title II that had been cited. Inspectors observed 8,230 violations of the safety provisions of Title II during these inspections, many of which were corrected immediately, thus obviating the need for

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issuing formal notices of findings thereon. However, 3,063 original notices setting a reasonable time for abating dangers not corrected promptly, 523 notices granting time extensions, and 3,041 notices certifying that the dangers had been totally abated were issued.

During the year 155 orders requiring the withdrawal of men were issued at 100 mines, 84 orders at 59 mines under the act's imminent danger clause and 71 orders at 41 mines for failure to show good faith in abating violations within a reasonable time. In addition 21 orders were issued classing mines gassy that had hitherto been considered nongassy; however, 5 of these orders were subsequently annulled by the Director or the Federal Coal Mine Safety Board of Review, an independent agency set up by the act following appeals by the operators.

Federal inspectors and engineers also made 6,827 routine inspections of the smaller Title I mines (including 595 inspections of strip mines); 1,012 technical surveys of electrical, ventilation, dust, blasting, and other practices and conditions; and 625 special investigations of fatal and serious nonfatal accidents, mine fires and gas and dust ignitions, and miscellaneous conditions.

During fiscal 1955, 7 applications for annulment of gassy-classification orders issued under Sec. 203(d) of the act were made to the Director; 6 were denied, and 1 was annulled. The Board received three applications for annulment of gassy-classification orders, all appealing adverse decisions by the Director. The Board annulled one order, and the Director has appealed this decision to the United States Court of Appeals - a hearing is pending. Other Board decisions are pending.

The Board also received two applications for annulment of withdrawal orders. One, issued under a State-participation plan, was annulled promptly upon abatement of the violation. The other, appealing an adverse decision by the Director, was annulled following a hearing. This action was appealed by the Director to the Federal Court, which dismissed the case because the appeal was not filed within the 30-day limit.

There were approximately 8,360 active coal mines in the Nation in calendar year 1954, including 1,570 Title II mines, 5,515 small Title I underground mines, and 1,275 strip mines. At the end of the fiscal year 1955, the Division of Coal Mine Inspection had 258 coal-mine inspectors, 45 engineers, 9 coal-mine electrical inspectors, and other supporting personnel variously assigned in coal-mine inspection and safety-education work (fig. 12).

One major coal-mine disaster, a widespread explosion and mine fire that caused the death of 16 men, occurred in the fiscal year 1955. This is the second disaster of major proportions (1 in which 5 or more persons are killed) in 3 years of operation under the antidisaster provisions of Title II of the act. The other was a dust explosion resulting in five deaths in the fiscal year 1953.

Preliminary figures indicate that the number of fatalities in coal mines dropped from 460 in calendar year 1953 to 395 in calendar year 1954, but the frequency rate per million man-hours exposure increased from 0.84 in 1953 to 1.04 in 1954. During the first 6 months of 1955, the preliminary fatality-frequency rate was 1.04. This unfavorable trend is usually experienced during periods of tight markets and marginal operation of coal mines and is influenced by the reduction in man-hours accompanying mechanization.

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Figure 12. - Federal coal-mine inspectors undergoing refresher course in mine rescue training at Experimental coal mine.

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CONTROL OF FIRES IN INACTIVE COAL DEPOSITS

Since 1949 the Bureau of Mines has engaged in controlling fires in inactive coal deposits on private property and the public domain. Up to fiscal year 1949, when the Congress first made funds available for such purposes, these fires had burned largely unabated. Uncontrolled fires in inactive coal beds have caused the loss of valuable coal reserves, damaged or destroyed surface property, and endangered the lives and health of persons living or working nearby. Many of the fires are in densely populated districts; others are in isolated sections. Some of the fires are in coal outcrops and originate from burning rubbish, brush fires, or camp fires; result from the carelessness of campers or hunters; or are caused by lightning. Other fires occur in abandoned coal-mine openings and may result from creeping outcrop fires or through carelessness or trespassers. Old fires in abandoned mines may break out from sealed areas or new fires may originate from spontaneous combustion.

Of the 196 known fires in inactive coal deposits, 46 have been controlled or are being controlled, 26 of which are on the public domain and 20 on private property. It is estimated that one quarter of a billion tons of coal have been conserved at a cost to the Government of less than 1 cent per ton for fire-control work.

During the fiscal year 1955, 8 fire-control projects were completed; 6 were on the public domain and 2 were on private property. Five additional fire-control projects were in progress at the end of the fiscal year.

Future plans include such maintenance work as may be necessary on completed projects. New fire-control projects will be initiated in the order of urgency and the availability of funds appropriated by Congress for this purpose.

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